BAKER BOTTS L.L.P. Attorney Docket No: A33383-072824.0112

PATENT

REMARKS

Claims 1-26 are pending. Claim 27 was cancelled, and claims 28-49 were withdrawn as directed to a non-elected species, in an earlier response. In this response, claim 1 is amended. Support for the amendment can be found throughout the application as filed, and in particular on pages 6, 8, 10, 19 and 20.

35 U.S.C. § 112 Rejections

Claim 2 has been rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. (OA, p. 3). In particular, the Office Action contends that it is unclear what is meant by "developable".

Applicant respectfully traverses. The term "developable" is well known to one of ordinary skill in the art. A "developable" surface is a surface that can be unrolled or unfolded into a flat plane. For example, a flat sheet of paper can be rolled into a cylinder or into a cone. Therefore, both cylinders and cones are developable surfaces. A sphere cannot be unrolled into a flat sheet without distortion; therefore, a sphere is not a developable surface. Applicant encloses examples of the use of the term "developable" as described above.

In view of the foregoing, Applicant respectfully requests that the rejection under 35 U.S.C. § 112 be withdrawn.

<u>35 U.S.C. § 103(a) Rejections</u>

Claims 1-4, 7-9 and 12-23 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 5,609,806 to Walsh et al. ("Walsh") in view of U.S. Patent No. 5,098,496 to Breitigam et al. ("Breitigam").

The Office Action contends that Walsh discloses "impregnating thermosetting resin into long parallel reinforcement fibers, partially curing the resin using ultraviolet radiation to form moldable prepregs, forming the prepregs into an article and curing the article." (OA, p. 3). The Office Action admits that Walsh does not teach the specifics of the final molding process and that Walsh does not disclose taking lengths of the prepreg and applying them to a nonplanar support by stacking to form a stack of stressed lengths. The Examiner contends that Breitigam discloses that it is well-known to form an article by stacking strips of prepreg on a shaped mold and curing them to form an article. The Examiner further concludes that it would have been obvious to one of ordinary skill in the art at the time the invention was made to mold the prepregs of Walsh using the molding technique of Breitgam, since this is a conventional technique used to mold fiber reinforced sheets.

Applicant respectfully traverses.

First, independent claim 1 requires exposing the composition to ionizing radiation "to obtain a precomposite in which said composition is in a solid phase." Neither Walsh nor Breitigam teach or suggest a precomposite comprising a composition in a solid phase.

The Office Action alleges that Walsh teaches "partially curing the resin using ultraviolet radiation to form moldable prepregs." (Office Action, p. 3). However, this allegation does not address the fact that the prepregs in Walsh are not in a solid phase. Rather, the

"formable prepreg" is an incompletely cured prepreg having only a "thicken[ed] thermosetting resin matrix." (Walsh, col. 2, line 41). The prepregs are not in solid form at this stage. As explained in Walsh, the resin in the prepregs is still viscous and has merely been "thicken[ed]" to "increase . . the viscosity of the resin such that the resin is transformed from a liquid to a non-dripping paste form. The resulting paste form of the resin is typically referred to as 'B-stage.'"

In contrast, in thc claimed invention, the resin-comprising composition of the precomposite of the claimed invention is not in the "B-stage paste form" discussed in Walsh, but rather is in a solid phase at this stage.

The instant specification discusses the significance of a precomposite in solid phase and explains that the resin of the precomposite of the present invention must be prepolymerized until it forms a solid medium (the so-called gelling stage or beyond). (Spec. p. 6).

Because the resin of the precomposites of the claimed invention are in a solid phase, the precomposites are resistant to buckling of its fibers upon the flexure that occurs when the lengths of the precomposite are stacked on the non-planar support. (*See* spec. p. 6, 10, and Table p. 20).

In contrast, the prepregs of Walsh are not in solid form. Because the prepregs of Walsh are in paste form, not solid form, the prepregs are not resistant to buckling upon flexure. The "paste" resin will not prevent the buckling of the fibers of the prepregs upon the flexure that would occur when applying the prepregs to a non-planar support.

Additionally, because the precomposites of the present invention are in a solid phase, the resin-based composition will not expand outside the precomposite during deformation

or during later heat treatment under pressure. (*See* spec. p. 10). The prepolymerization of the resin to obtain a composition in a solid phase makes it possible to avoid the flow of resin during later treatment. (Spec. p. 6). The precomposite has sufficient cohesion to be installed in an open mold, with the mechanical stresses which this presupposes, without risking "wringing" of the fibers during which the amount of resin of the preform would decrease uncontrollably.

Thus, Walsh does not teach or suggest a precomposite in which the composition is in a solid phase, and Breitigam does not teach or suggest these missing limitations. For at least this reason, the cited art does not render the claimed invention obvious.

To make it clear that a precomposite in which the composition is in a solid phase is resistant to buckling of its fibers upon the flexure that occurs when the lengths of the precomposite are stacked on the non-planar support, claim 1 has been amended to recite "a precomposite in which said composition is in a solid phase <u>such that said precomposite is resistant to buckling of said fibers upon flexure</u>." No change of claim scope is intended by this limitation, as a precomposite in which said composition is in a solid phase is resistant to buckling of its fibers upon the flexure that occurs when the lengths of the precomposite are applied to a non-planar support.

Additionally, Walsh does not teach or suggest taking lengths from the precomposite in which the composition is in a solid phase ("solid precomposites" in shorthand) and applying them to a non-planar support by stacking the lengths of solid precomposites on one another. Nor does Walsh teach or suggest how to arrange solid precomposites so as to fit snuggly against a non-planar support. Breitigam does not satisfy these missing limitations.

The Office Action contends that it is "conventional" to form an article by stacking strips of prepreg on a shaped mold and curing them to form an article. The Office Action further contends that one skilled in the art "would understand that the prepregs would be fitted snugly against each other to prevent gaps which reduce the strength of the final product" and that "one in the art would appreciate that any type of mold could be used dependent of the intended final product shape, and that it would have been obvious to use a nonplanar mold when forming a nonplanar article." (OA, p. 4).

Applicant strongly disagrees that any such knowledge is common or well known in the art. Applicant requests the Examiner provide a citation to a reference or an affidavit showing that such information is conventional or well known in the art. (M.P.E.P. § 2144.03).

The challenge in the prior art has precisely been how to efficiently and effectively produce nonplanar articles that have the same stress-resistant properties akin to analogous planar monolithic materials. Prior to the present invention, one skilled in the art could not mold a solid prepreg/precomposite against a nonplanar support and obtain a composite having superior stress resistant properties because the bending of the solid prepregs would create internal stresses in the prepregs that would weaken the strength of the prepregs. Use of non-solid prepregs would decrease the internal stresses of the prepreg upon molding on the non-planar support, but has the problem associated with non-solid resin. The present invention provides a new and novel method of manufacturing that utilizes solid precomposites to produce a composite having superior stress-resistant properties.

Neither Walsh nor Breitigam teach or suggest stacking solid precomposites to fit against a non-planar support. Both Walsh and Breitigam use non-solid structures which only

reach the solid stage after they have been formed into shape. Thus, contrary to what is suggested in the Office Action, Walsh does not suggest fitting solid precomposites/prepregs snuggly against each other and the support.

The Office Action has not provided any evidence that stacking solid precomposites against a non-planar support, as required in the claimed invention, is conventional or well known in the art.

The novel invention of the present application solves the problem of the prior art by joining lengths of precomposite, each having a reactive surface, in a manner that controls the amount of polymerization so as to create a high-performance nonplanar article. Thus, the presently claimed method for manufacturing high-performance nonplanar composite parts is not disclosed by either Walsh or Breitigam and would not have been obvious to a person of ordinary skill in the art from the disclosures of the combined references.

In light of the above traversal with respect to the rejections over Walsh and Breitigam, applicant respectfully requests withdrawal of the rejection of claims 5-6, 10-11, 24 and 26 under 35 U.S.C. § 103(a).

In view of the foregoing remarks, Applicants respectfully request withdrawal of the objections and rejections, and allowance of all the pending claims.

BAKER BOTTS L.L.P.

Attorney Docket No: A33383-072824.0112

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CONCLUSION

The Commissioner is hereby authorized to charge the two month extension of time fee of $410.00 to Deposit Account 02-4377. Applicant does not believe that any additional fee is required in connection with the submission of this document. However, should any fee be required, or if any overpayment has been made, the Commissioner is hereby authorized to charge any fees, credits or overpayments to Deposit Account 02-4377.

Respectfully submitted,

BAKER BOTTS L.L.P.

Dated: April 7, 2003

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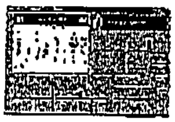

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In the early web days this site was known as Wahoo's CAD/CAM Page and was hosted at neca.com. Wahoo's CAD/CAM Page was one of the first devoted to CAD/CAM and CNC Machining. Much of what is here now is a rewrite (yes, all was lost while I worked for CAD/CAM developers, etc.) and updated version of the most frequently visited pages from the old site.

XMLCreate by Wahoo Software creates custom software, web forms, and applications written in XML, Java, JavaScript, C, and C++ to fit any need. We specialize in the CAD/CAM industry with over 15 years experience in this field.

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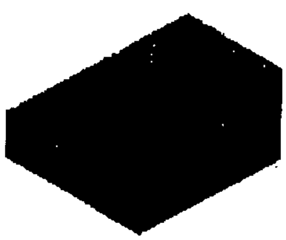

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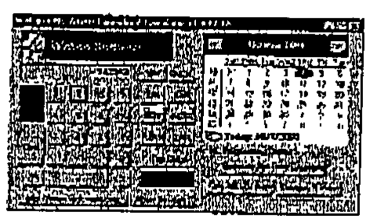

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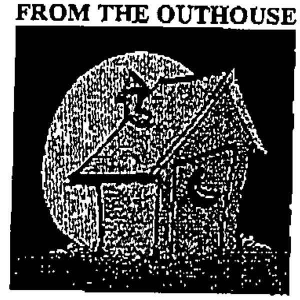

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CADCAM Workshop: Todays topic: Solid Modeling
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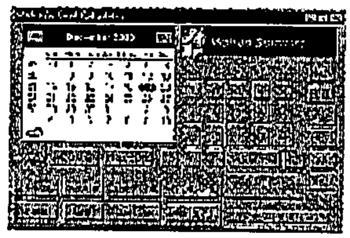

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UPCOMING TRADE SHOWS 2001

EMO Hannover, Germany Sept. 12-19

LOBOS Industrial Show 2001 Baton Rouge, LA Industrial Show Riverside Centroplex Baton Rouge, LA Sept. 19-20

RTMA Tool Show Rochester Riverside Convention Center, Rochester NY Sept. 25-27

2001 SPE Annual Technical Conference and Exhibition New Orleans, LA Sept. 30-Oct. 3

Wisconsin Manufacturing Expo Milwaukee State Fairgrounds Oct. 2 - 4

Mid-Atlantic Machine Tool Show Fort Washington Expo Center, Fort Washington Oct. 2 - 4

SEMICON Southwest 2001 Austin

There's an ongoing issue in the CAD/CAM/CNC newsgroup lately having to do with **developable and non-developable surfaces.**

So, what is a developable surface? Basically, it is any surface that can created from a shaped flat plane without stretching it, creasing it, or tearing it. Think of the surface as if built from a piece of sheet metal. Could you create the surface shape by bending, twisting, and/or flattening a piece of sheet metal without having to stretch or tear the sheet? If you answer yes, then it is a developable surface. If you can't create the surface shape without streching, creasing, or tearing, it's a non-developable surface.

Simple developable surface types are cones, cylinders, swept surfaces and the like. As long as you keep multiple developable surfaces tangent to each other, the group remains developable.

What's the big deal? As long as the part designer creates the part with developable surfaces and keeps the group tangent, the thoery is that the part can be manufactured easier and more likely gouge free easier than using non-developable surfaces. Perhaps more importantly, developable surfaces can be mapped, or unwrapped, back into a plane for advanced machining applications such as 5 axis simultaneous machining or applications requiring a rotary axis substitution for a linear axis.

Recent advances in developable surface mathamatics (most notably by Helmut Pottmann) is having a major impact in NURB surface definition technology available to CAD and CAD/CAM developers.

Much of the arguement focuses on whether the CAD/CAM companies who have not already done so will revamp their older surfacing methods to implement the benefits of developable surface techniques.

"Developable"

The Form, Case and Asp ct of a Projecti n

Given that all map projections have the same basic elements -- a model of the Earth, a developable surface, and a light source -- how does one projection differ from another? In addition to differences in the type of light source used, there are three other major differences among projections: Projections differ in their form, case, and aspect.

The form of a projection refers to the shape of the developable surface. The developable surface can take any shape that can later be straightened out to form a flat map. Many complex forms are possible, but most maps are made using planner forms, where the developable surface takes the shape of a flat plain; cylindrical forms, where the developable surface is rolled into a cylinder; or conic forms, where the developable surface is wrapped into a cone (Figure 1).

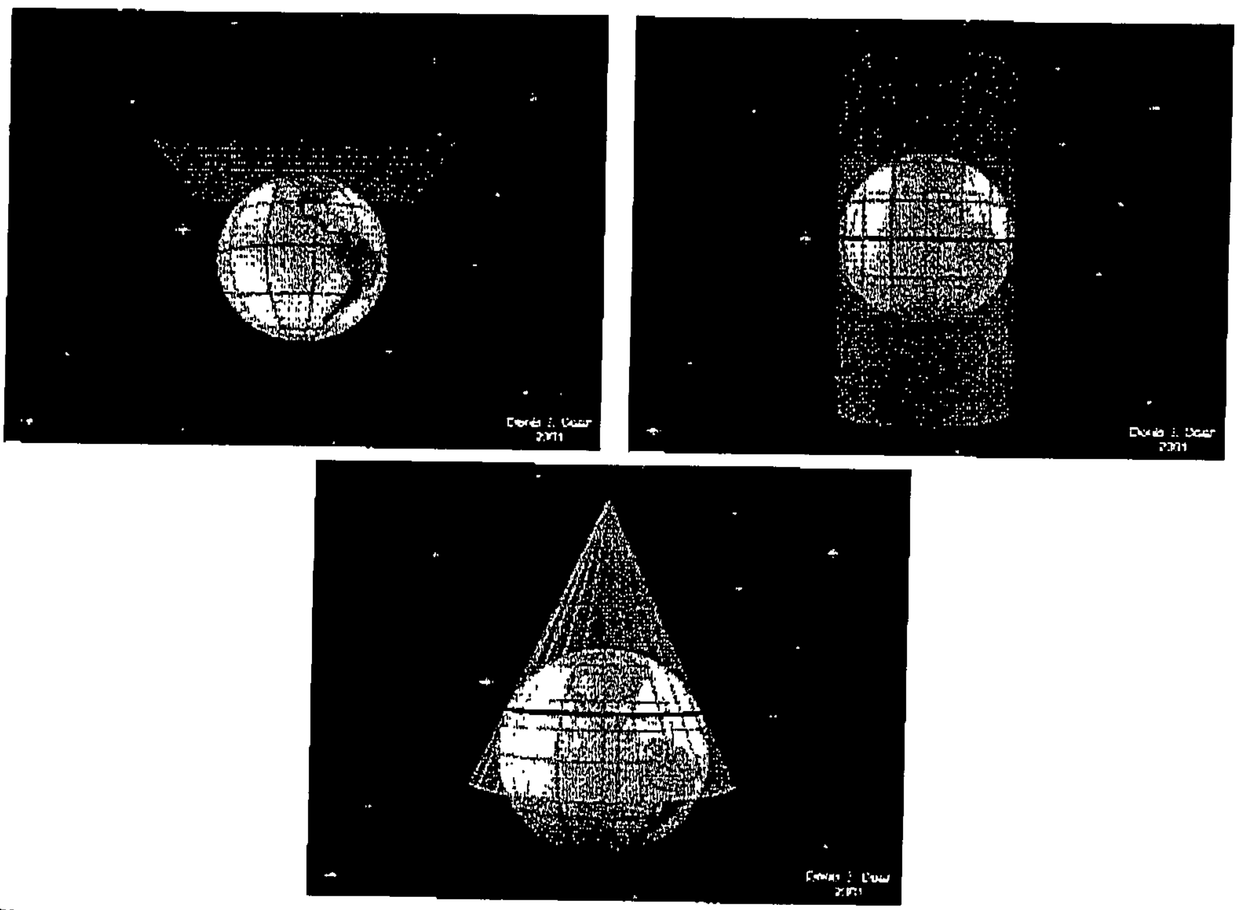


Figure 1. Planner (top left), cylindrical (top right) and conic (bottom) forms. Note that the point or line of tangency is highlighted in each image. Further note that each example is based on a projection with a normal aspect.

The case of a projection describes how close the developable surface comes to the model of the Earth. Maps are typically made using either tangent or secant cases. The tangent case implies that the developable surface just touches the surface of the model of the Earth, while the secant case implies that the developable surface cuts through the surface of the model of the Earth (Figure 2).

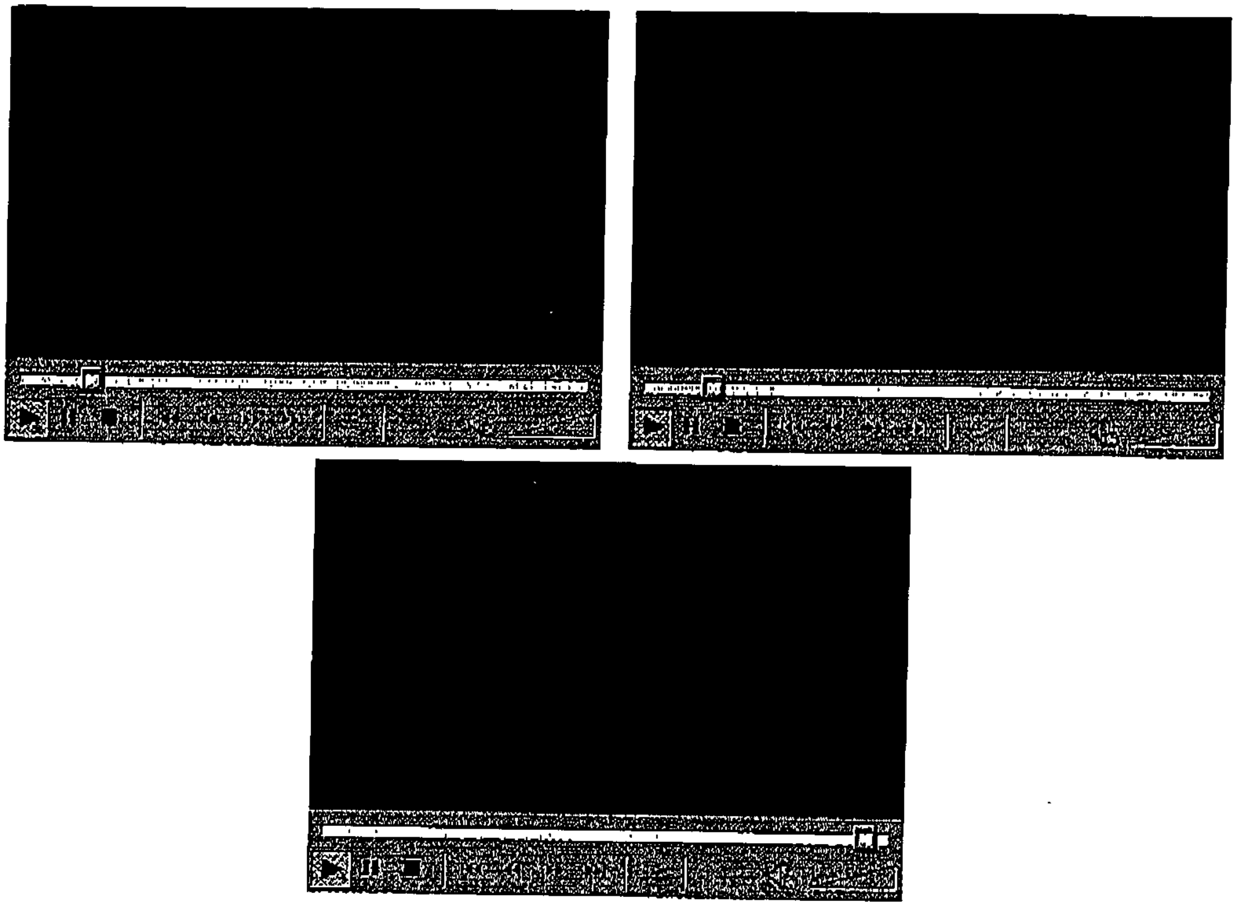


Figure 2. Tangent (top left), secant (top right) and ommissive (bottom) cases of a planner projection. In the tangent case, the developable surface touches the model of the Earth in exactly one place. In the secant case, the developable surface cuts through the model of the Earth. In the ommissive case, the developable surface does not touch the model of the Earth. Note that all of these projections have transverse aspects. The line of tangency (or, in the case of the tangent planner projection, the point of tangency) for each projection is highlighted. Further note that the ommissive case has no point or line of tangency.

A third case (called ommissive) is created when the developable surface fails to touch the surface of the model of the Earth. The ommissive case is rarely used in modern mapmaking because it always contains more error than do similar tangent or secant cases.

The aspect of a projection determines the relative positions of the developable surface and the model of the Earth. For example, consider the examples shown in Figure 3. Both examples show tangent, cylindrical projections, but the relative positions of the of the developable surface and the model of the Earth are very different. This produces radically different maps, as shown in Figure 4.

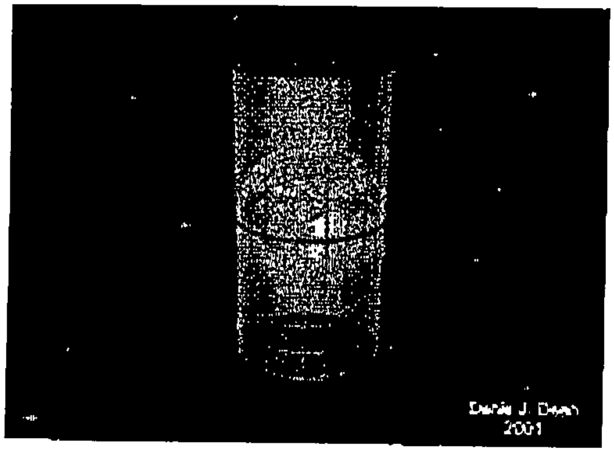
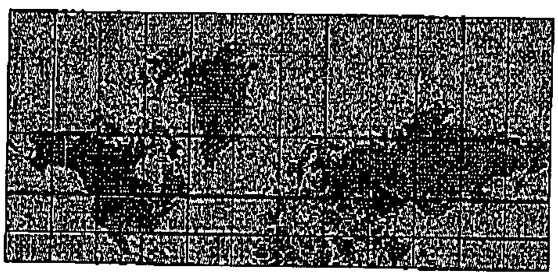


Figure 3. The relationships between the model of the Earth and the developable surfaces used in maps with normal (left) and transverse (right) aspects.



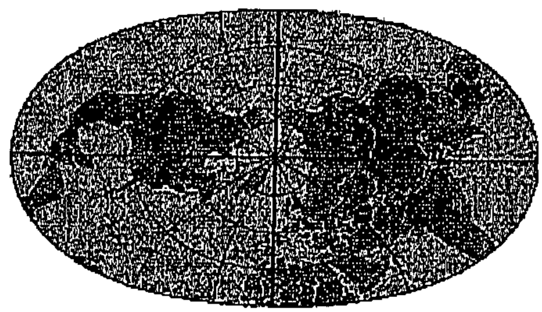
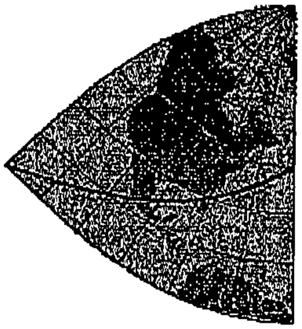


Figure 4. Maps produced using differing aspects. On the left, the map is a normal Mercator projection with the line of tangency running along the 50 degree line of latitude (this line of tangency is highlighted in blue in the left hand map). The map on the right is a transverse Mercator with the line of tangency running along the 0 and 180 degree lines of longitude (once again, this line of tangency is highlighted in blue in the right hand map).

Geodetic scientists recognize three types of aspects. An aspect that places the line of tangency along lines of latitude, is termed a normal aspect. Aspects that place the line(s)of tangency along lines of longitude is termed a transverse aspect Finally, anything in-between (i.e., an aspect that places the line (s) of tangency along neither lines of latitude nor along lines of longitude), is termed an oblique aspect (Figure 5).



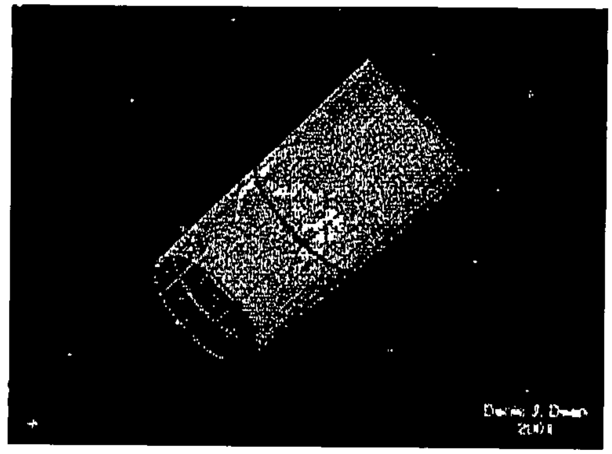


Figure 5. An oblique Mercator map (left) and the relationship between the model of the Earth and the developable surface used to build oblique maps (right). This map's line of tangency (highlighted in blue) runs from a point located at -140 degrees, 0 minutes, 0 seconds longitude; 0 degrees, 0 minutes and 0 seconds latitude to a second point located at -50 degrees, 0 minutes 0 seconds longitude; 45 degrees, 0 minutes and 0 seconds latitude.

Class: IUE_developable_surface

Implementation Status: Implementation scheduled for V2.0 (IUE Libraries)

Date generated: August 5, 1996

[Related Classes] [Attributes] [Constructors] [Methods] [Developer's specification] [Source Code]

A surface which can be unrolled onto a plane without distortion. Included for completeness but will not be part of the IUE core.

Instantiable Class (instances can be created)

Superclass(es) :

IUE_parametric_surface_mixin
IUE_surface

Design choices:

List of Attributes

Attributes defined in IUE_developable_surface

Attributes inherited from IUE_parametric_surface_mixin

Attributes inherited from IUE_surface

Attributes inherited from IUE_spatial_object

- coordsys

Attributes inherited from IUE_relation

Attributes inherited from IUE_object

- annotations
- print_depth_limit
- name
- prop_list

List of Methods

GISDataDepot - Data Projections

Data Projections

- Albers Equal-Area Conic
- Cassini
- Cylindrical
- Equidistant Conic
- Equidistant Azimuthal
- Lambert Conformal
- Lambert Equal Area
- Mercator Projection
- Miller Cylindrical
- Mollweide Projection
- Planar perspective
- Robinson
- UTM

Some Key Terms (supplied by USGS)

Azimuth—The angle measured in degrees between a base line r from a center point and another line radiating from the sam Normally, the base line points North, and degrees are measu from the base line.

Aspect—Individual azimuthal map projections are divided int the polar aspect which is tangent at the pole, the equatori is tangent at the Equator, and the oblique aspect which is (The word "aspect" has replaced the word "case" in the mode

Conformality—A map projection is conformal when at any poin same in every direction. Therefore, meridians and parallels angles and the shapes of very small areas and angles with v preserved. The size of most areas, however, is distorted.

Developable surface—A developable surface is a simple geometric form capable of being flattened without stretching. Many map projections can then be grouped by a particular developable surface: cylinder, cone, or plane.

Equal areas—A map projection is equal area if every part, a

Devel pable Surfaces

A developable surface is the "intrinsically flat" surface that receives the shadows cast by opaque objects on the model of the Earth. The developable surface ultimately becomes the map produced by the projection process (Figure 1). "Intrinsically flat" means that a developable surface can be unrolled or unfolded into a flat sheet. Think of the developable surface as a piece of paper. You can role a sheet of paper into a cylinder (Figure 2) or a cone (Figure 3), so both cylinders and cones are valid developable surfaces. Any other shape you can think of that can be unfolded or unrolled into a flat sheet could also be used as a developable surface. However, some shapes can't be unrolled or unfolded into flat sheets, and these shapes cannot be used as developable surfaces. For example, it isn't possible to unroll a spherical surface like the surface of a spheroid, an ellipsoid or a geoid, into a flat sheet, so these spherical surfaces cannot be developable surfaces.

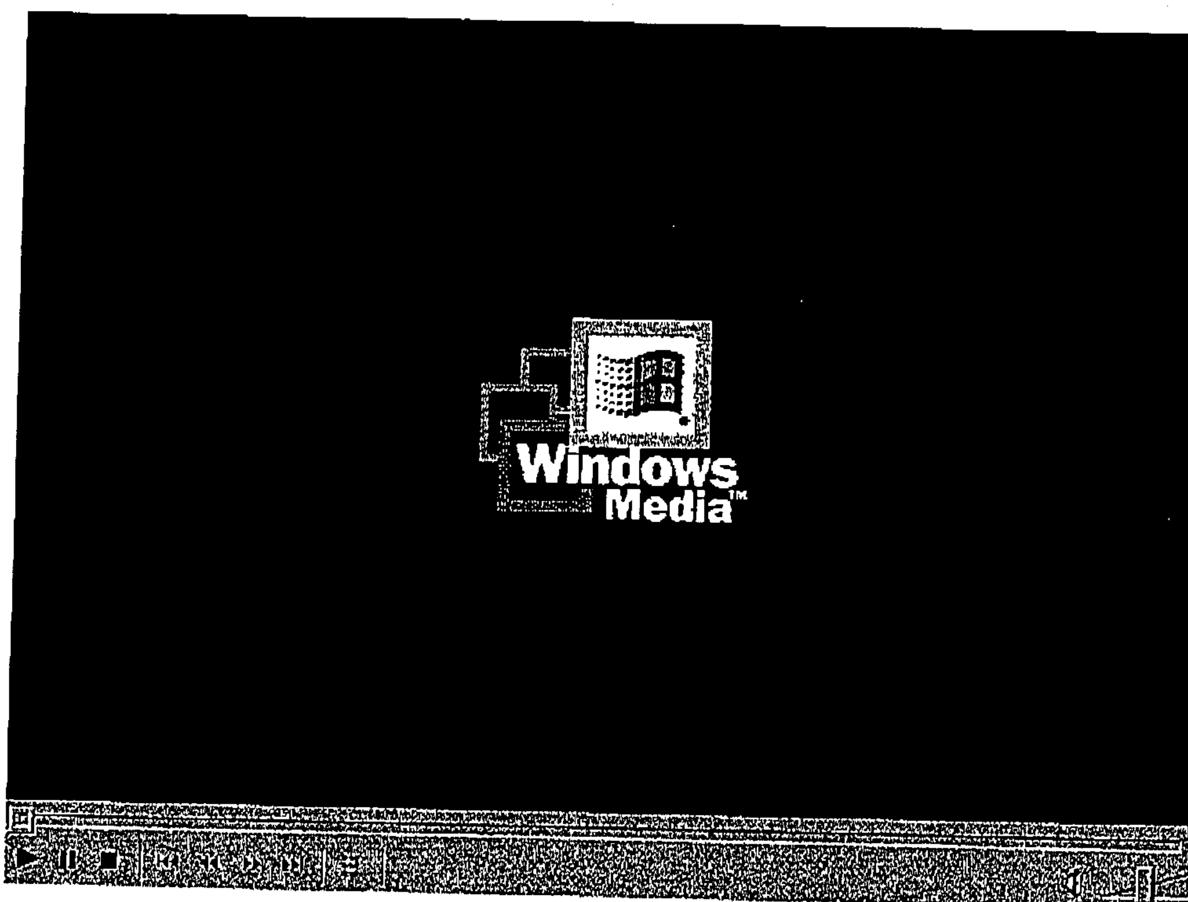


Figure 1. The fundamental components of the projection process.

The term *developable surface* comes from

Figure 2. Rolling a flat developable surface into a cylinder.

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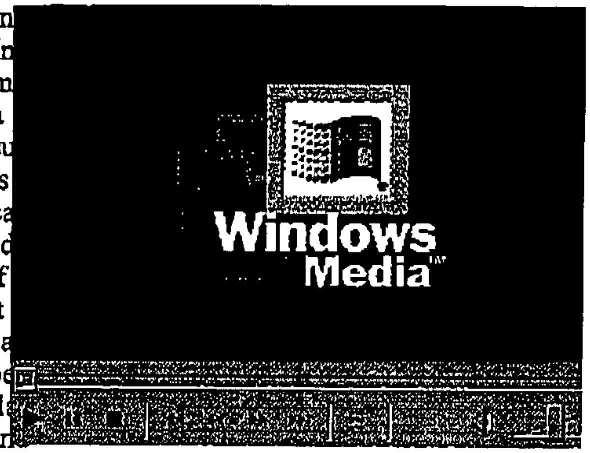


Figure 3. Rolling a flat developable surface into cone.

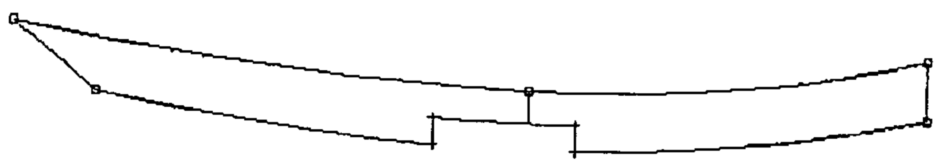
an *undevelopable surface* if it cannot be flattened. Using these definitions, the whole purpose of the projection process is to transfer locations from an undevelopable surface -- the surface of the model of the Earth -- to a developable one. Indeed, this is how a mathematician would define the projection process.

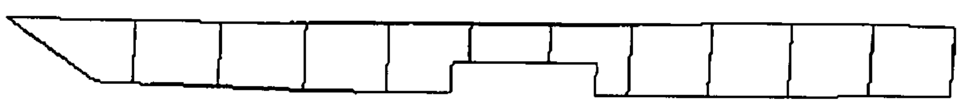
Pilot3D "3D For All"

Surface Development and Layout

7 Pilot3D gives you an easy way to unwrap or layout your singly (developable) or doubly (expandable) curved surface. If a surface has too much double curvature, Pilot3D even gives you a way to subdivide the surface and unwrap the pieces. To learn more about the details of unwrapping developable and non-developable surfaces, see our white paper called "Plate Development and Expansion".

Unwrapping a surface is very simple. You just pick the surface to unwrap and the program displays the 2D pattern. This shape can be printed or plotted directly at any scale factor or it can be output to a DXF file to transfer to a CNC cutting machine program.



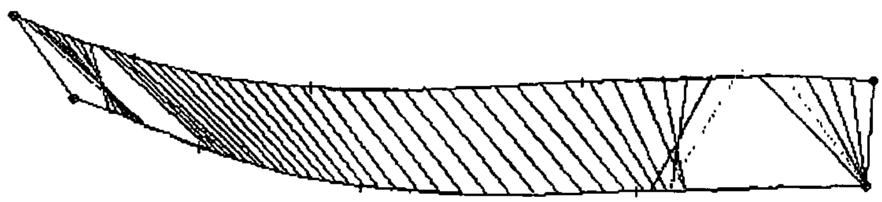


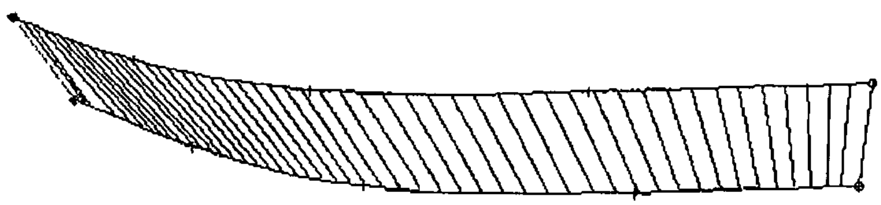
The top picture is a side view of a trimmed or notched surface and the bottom picture is its 2D developed pattern, including trace lines for a series of planar surface intersections. Pilot3D can even draw surface-surface intersection trace lines on the pattern.

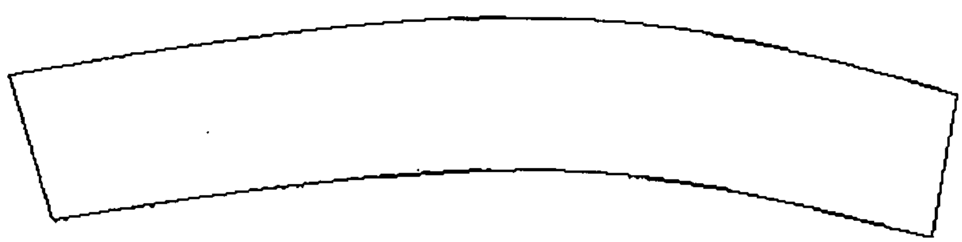
If the surface has double curvature, Pilot3D will flatten it out into its 2D shape and give you information about the maximum stretch in the pattern. You can even tell the program how much perimeter stretch is allowed. The program can do this because it uses a finite element type of calculation where it solves a huge system of equations. Pilot3D does not use a simple triangularization and layout technique.

If you want to design a surface and make sure that it is developable (no double curvature), Pilot3D gives you th tools to do that easily. Other programs might give you information about the developablity of a surface (using Gaussian curvature, for example), but they

don't tell you how to change the shape to make it developable. Pilot3D, on the other hand, uses our unique dynamic ruling line technique that recalculates the ruling lines while you are editing the shape of the boundary curves and colors them based on the amount of twist in the surface. This means that you can edit and smooth the surface edges and get immediate feedback on the developability of the surface. Once you have the edge curves and the ruling lines just right, Pilot3D will automatically fit a NURB surface through the set of ruling lines.

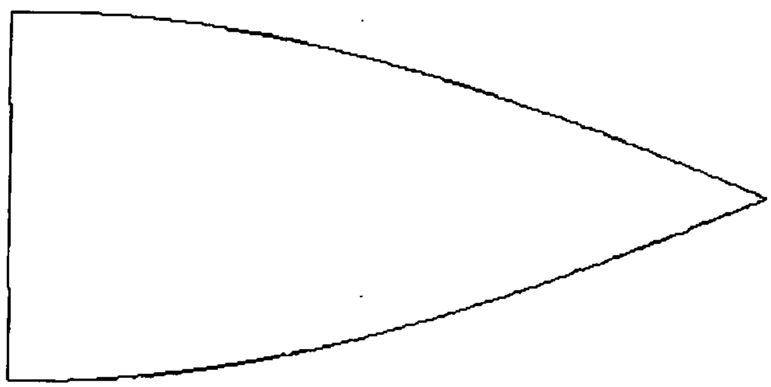






The top picture shows a 3D view of two NURB curves with ruling lines calculated and drawn in-between. Dark blue ruling lines indicate a developable shape that can be unwrapped without distortion. The other colors indicate higher levels of twist between the two curves. To correct the problem areas, all you have to do is use the Move Pnt and the Move Pnt% (this is the fine-tune move command) on the curve edit points and dynamically watch how the ruling lines and their colors change. It took a minute or so to correct the two curves to create one (in the middle) that has a nice spread of dark blue ruling lines. This means that the surface if completely developable. The bottom picture shows the 2D pattern generated from the NURB surface that was fit to the ruling lines. Also note that you can turn on the curvature fairing curves so that you can monitor the smoothness of the curves while you are creating a dev lopable surface.

No other program in the world has this dynamic ruling line capability! If you need to design complex surfaces that have to be unwrapped into 2D patterns, then Pilot3D makes your job very easy. You just define the edge curve shapes and Pilot3D takes care of the rest. No more guessing on ruling lines or using Gaussian curvature!



The top picture shows an octagon-shaped umbrella that could be made out of any flat material, like canvas. Each panel was created using ruling lines between the edge curves and fit with a NURB surface. The bottom picture shows the developed shape of one of these panels. The 3D model took about 10 minutes to create and the layout pattern took just one step. Then it is just one more step to output the shape to a plotter or a DXF file.

For another example, see the st p-by-step tutorial on creating a half cone with a trimmed out star shape and see how it was flattened out.